GPU Nuclear

S D 15737-2-M72-DWC02 REV 3

ISSUE DATE 3/19/85

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TMI-2

DIVISION

SYSTEM DESCRIPTION

FOR

DEFUELING WATER CLEANUP

FUEL TRANSFER CANAL/SPENT

FUEL POOL CLEANUP SYSTEM

(ECA 3525-84-0041)

COG ENG AK Boldt DATE 8/27/84

RTR R L Mays DATE 8/27/84

COG ENG MGR. AK Boldt for R.L. Rider DATE 8/27/84

NO.	DATE	REVISIONS	BY	CHECKED	GROUP SUPERVISOR	MGR DESIGN ENGINEERING
3	3/19/85	See Change Summary on Page 2	[signature]	[signature]	[signature]	AKB
2	12/27/84	See Change Summary on page 2	[signature]	[signature]	[signature]	[signature]
1	11/28/84	Added K-2 (see Change Summary)	[signature]	[signature]	[signature]	[signature]
0	8/27/84	Issue For Use	[signature]	[signature]	[signature]	[signature]
				CHIEF ENGR		

FORM 4000-ENG-7310.06-1 (5/84)

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Rev.	SUMMARY OF CHANGE
1	DWC ion exchanger K-2 dedicated to FTC/SFP Cleanup System and made primary routing for Cs-137 removal with SDS now as a backup. Added to sections 1.3.1, 1.3.2, 1.6.3, 1.6.4, 2.1, 2.2, 3.1, 3.2, 3.4, 3.5 and 4.2 information on K-2 given previously in system description 2-M72-DWC01 (Ref. 13). Any information added to or changed from that given previously in Ref. 13 is listed below.
1	Added capability to bypass level switch on K-2 (section 3.5) for draining and filling.
1	Added low & high level set points for K-2 level switches LSL-40 and LSH-40.
1	Deleted plug valve V100. Now use V099 to isolate 4 inch hose on return line to the FTC.
1	Completed description of Ref. 18f. Added Ref. 18k through 18q, 19, 20, 21 and 22.
1	Added capability to route to K-2 & SDS simultaneously.
1	Inlet/Outlet manifolds for filter canisters are not skid mounted.
1	Normal operational mode now is 400 gpm from FTC filtered and returned to Fuel Pool A. 30 gpm is also processed in K-2.
1	Cesium concentration levels changed to read equivalent cesium concentration.
2	Deleted section 4.3; corrected ref. 22b; revised ion exchanger model, ASL-17 setpoint; made method of filling/refilling optional in sections 3.1 and 3.6; revised wording in section 4.4; corrected pump number in section 4.5; delete sentence section 2.3.
3	Added relief valves R-8, R-9, R-10, & R-11 to protect filter canisters. Added locations of sample points. Provided detailed information on sample boxes 1 and 2 and their exhaust systems. Deleted boronometer AE-17. Added references 18 r, s, t, u, 22 a, d, e, 23, and 24. Added precautions for pump changes and sample box 2 face velocity. Provided more detailed valve lineup for startup. Revised section 5.0 to delete forthcoming information.

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1.0 DESIGN DESCRIPTION

1.1 Summary

The fuel transfer canal/spent fuel pool cleanup system is a temporary liquid processing system which is designed to process water contained in the spent fuel pool and/or the fuel transfer canal. The system's major functions are:

a) to filter the water contained in the spent fuel pool and/or the fuel transfer canal to remove suspended solids above a nominal .5 micron rating. This is done to maintain the clarity of the water to a 1 NTU rating.

b) to remove soluble fission products from the spent fuel pool or the fuel transfer canal by demineralization of the water. This is done to keep the equivalent Cs-137 concentration less than .02 μci/ml and thus reduce the dose rate contribution of the water. Also, a flowpath to EPICOR II via the RCBT's is provided to remove Sb-125 in the event that high Sb-125 levels are encountered.

1.2 References

1. Planning Study, Defueling Water Cleanup System Doc. No. TPO/TMI-046

2. Technical Plan, Defueling Water Cleanup System Doc. No. TPO/TMI-047

3. Division I, System Design Description, Defueling Water Cleanup System Doc. No. 2-R72-DWC01

4. Bechtel Drawing 2-M74-DWC01, Defueling Water Cleanup (DWC) Reactor Vessel Cleanup System P&ID

5. Bechtel Drawing 2-M74-DWC02, Defueling Water Cleanup (DWC) Fuel Transfer Canal/Spent Fuel Pool Cleanup System P&ID

6. Bechtel Drawing 2-M74-DWC03, Defueling Water Cleanup (DWC) Auxiliary Systems P&ID

7. Bechtel Drawing 2-POA-6401, General Arrangement Fuel Handling Building Plan El. 347'-6"

8. Bechtel Drawing 2-POA-1303, General Arrangement Plenum Removal Reactor Building

9. DCN No. 2026-30-2, Flow Diagram Spent Fuel Cooling and Decay Heat Removal

10. Burns & Roe Drawing No. 2026, Flow Diagram Spent Fuel Cooling and Decay Heat Removal

11. GPU Drawing No. 2R-950-21-001 P&ID Composite Submerged Demineralizer System

12. TMI-2 Recovery Division System Design Description for Submerged Demineralizer System, Doc. No. SD 3527-005

13. Division System Design Description for Reactor Vessel Cleanup System, Doc. No. 15737-2-M72-DWC01

14. Instrument Index, Doc. No. 15737-2-J16-001

15. Design Engineering Valve List, Doc. No. 15737-2-P16-001.

16. TMI-2 Recovery Mechanical Equipment List, Bechtel North American Power Corp., Job 15737

17. Standard For Piping Line Specifications, Doc. No. 15737-2-P-001.

18. Bechtel Piping Isometrics

    a) 2-P60-DWC01-DWCS-Pumps P-2A&B, P-3A&B, P-4A&B, and Miscellaneous Details

    b) 2-P60-DWC02-DWCS - Reactor Vessel Filter Trains A & B - Inlet Manifold Piping

    c) 2-P60-DWC03-DWCS - Reactor Vessel Filter Trains A & B - Outlet Manifold Piping

    d) 2-P60-DWC04-DWCS - Transfer Canal/Fuel Pool Filter Trains A & B - Inlet Manifold Piping

    e) 2-P60-DWC05-DWCS - Reactor Vesel Filter Train Sample Lines

    f) 2-P60-DWC06-DWCS - Discharge Piping from Sample Boxes No. 1 & No. 2 to Penetration R-537

    g) 2-P60-DWC07-DWCS - Samples Lines Upstream & Downstream of Ion Exchangers

    h) 2-P60-DWC08-DWCS - Forwarding Pumps P-6 and P-7, Suction & Discharge Piping

    i) 2-P60-DWC09-DWCS - Forwarding Pumps P-6 and P-7 Discharge Piping

    j) 2-P60-DWC10-DWCS - Supply Piping to Ion Exchangers K-1 & K-2, Supply & Discharge Piping from Post Filter F-8

    k) 2-P60-DWC11-DWCS - Supply Piping to Ion Exchangers K-1, K-2, and K-3 3

    l) 2-P60-DWC12-DWCS - Borated Water Flush Piping from SPC-T-4

m) 2-P60-DWC13-DWCS - Transfer Canal/Fuel Pool Filter Trains "A" & "B" Outlet Manifold Piping

n) 2-P60-DWC14-DWCS - Transfer Canal/Fuel Pool Filter Trains "A" & "B" Outlet Manifold Discharge Piping, Supply & Discharge to Booster Pump P-5

o) 2-P60-DWC15-DWCS - Nitrogen Supply Piping to SPC-T-4 and Drying Station | 3

p) 2-P60-DWC16-DWCS - Discharge Piping from DWC Booster Pump P-5

q) 2-P60-DWC17 DWC Miscellaneous Piping Details

r) 2-P60-DWC18 - DWCS - Miscellaneous Piping Details

s) 2-P60-DWC19 - DWCS - Sample Panel No. 1, FHB | 3

t) 2-P60-DWC20 - DWCS - Sample Box No. 2, FHB

u) 2-P60-DWC21 - DWCS - Sample Panel No. 2 Drain & Return to Spent Fuel Pool A.

19. ECA No. 3245-84-0034 - Defueling Water Cleanup System Penetration Modifications

20. ECA No. 3525-84-0041 - Definition of the Defueling Water Cleanup System (DWCS)

21. ECA No. 3527-84-0042 - SDS Tie-in to DWCS

22. Bechtel Area Piping Drawings

    a. 2-P70-DWC02 - Instrument Air Manifolds & Hose Routings for DWCS - Reactor & FHB

    b. 2-P70-DWC03 DWCS Hose Network Reactor Bldg. Plan El. 347'-6"

    c. 2-P70-DWC04 DWCS Hose Network Fuel Handling Bldg. Plan El. 347'-6"

    d. 2-P70-DWC05 - DWC System Hose Network Sections and Details

    e. 2-P70-DWC06 - DWCS - Process Hose Schedule - Reactor & FHB

23. TER-15737-2-G03-106, TMI-2 Division Technical Evaluation Report for Defueling Water Cleanup System | 3

24. TER-15737-2-G03-114, TMI-2 Division Technical Evaluation Report for Defueling Canisters

1.3 Detailed System Description

1.3.1 Description

The fuel transfer canal/spent fuel pool cleanup system is a liquid processing system which can process water from the spent fuel pool and/or the fuel transfer canal. For the corresponding P&ID's see references 4, 5, and 6. Some valves identified herein have been given an instrumentation designator as well as a valve number. When this occurs, the instrument designator is shown in parentheses after the valve number.

The spent fuel pool (SFP) and the deep end of the fuel transfer canal (FTC) will be filled with water to a level of 327 ft.-8 in. A dam with top elevation 328 ft.-2 in. separates the shallow and deep ends of the FTC.

Two vertical submersible well pumps, P-3A/B, are located in the FTC. Each is capable of pumping a net 200 gpm. A 20 gpm continuous recycle protects the pump motor. P-3A/B take suction from trough-type skimmer U-7 via a 6 inch flexible hose. A secondary, 4 inch, subsurface inlet below the skimmer will prevent pump starvation due to skimmer congestion.

Pumps P-3A/B discharge to the FTC/SFP filter canisters via Reactor Building penetration R-524. The internals of check valve SF-V190 are removed to make use of existing piping connected to R-524.

Two vertical submersible well pumps, P-4A/B, identical to P-3 A/B in the FTC, are located in the SFP. P-4A/B take suction from trough-type skimmer, U-8, similar to U-7.

The system has four particulate filters, each capable of filtering a flow of 100 gpm. The filters are contained in modified fuel canisters submeraed in the SFP to provide the appropriate radiation shielding. These filters are capable of removing debris, mainly fuel fines (UO_2) and core debris (ZrO_2), down to a 0.5 micron rating. Since the canisters contain fuel fines, they are designed to prevent a criticality condition from existing when they have been loaded.

The four pumps and four filters are normally manifolded so one pump from each source discharges to one pair of filters. Therefore, the filtration portion of the system is divided into two trains. Train A contains pumps P-3A and P-4A and filter canisters F-9 and F-10. Train B contains pumps P-3B and P-4B and filter canisters F-11 and F-12. In the normal mode the system filters 400 gpm from the FTC and returns the filtrate to the SFP. The system can be manifolded to filter 200 gpm from the FTC and 200 gpm from the SFP or 400 gpm from either source. This pump arrangement provides both flexibility in operations and the redundancy to permit continued operation during pump maintenance.

A filter canister is used continuously until the differential pressure reaches a set point (See section 2.2). At this point the system is shutdown and then, after a waiting period of approximately 5 minutes, it is restarted. The differential pressure is noted and if it returns to a low value the system will be run again to the pressure setpoint. This process is repeated until the differential pressure at restart reaches a value near the shutdown setpoint. When this occurs within one hour of restart, the train is shutdown and the filters are replaced.

Loaded canisters are expected to generate small quantities of oxygen and hydrogen gas due to radiolysis of water. Pressure relief valves R-8, R-9, R-10 and R-11 are
provided on the filter canister outlet lines upstream of 3
their isolation valves. Their purpose is to prevent overpressuring the filter canisters when isolated due to the small quantities of H_2 and O_2 produced (approximately 0.029 ft^3/day).

Filter canisters are not reusable. The filter canisters are connected to inlet and outlet manifolds via 2-1/2 inch flexible hoses with cam and groove couplings.

Once the water has been filtered, all, or a portion of the flow can be returned to its source (either the SFP or the FTC). The amount of water pumped from its source is controlled by manually adjusting globe valves V097 A/B. The return path to the FTC uses Reactor Building penetration R-539. At each source the return path splits into two 2-inch returns to provide back pressure to valves V097 A/B. One two inch return is used for 200 gpm operation; both are used for 400 gpm operation.

A portion of the flow not returned directly to source can be further processed through either the DWC ion exchanger K-2 or the submerged demineralizer system (SDS). Routing to the SDS is provided as a backup to K-2 and to augment total processing capability during times of high cesium concentration in either source. The DWC ion exchanger K-2 can process 30 gpm. The ion exchange media is a bed of zeolite resin which will remove Cs-137. The resin is contained in a 4 x 4 liner, similar to those used in EPICOR II. K-2 influent is regulated by flow control valve V085 (FV-15) while K-2 effluent is regulated by level control valve V070 (LV-46). If either high or low levels occur in K-2, LSH-40 or LSL-40 will trip both isolation valve V069, halting influent, and solenoid valve V156, shutting off air supply to DWC forwarding pump P-7, thus halting effluent.

Two post filters are provided. Filter canister post filter F-8 protects K-2 from suspended solids in the event of a canister filter media rupture. DWC post filter F-7 is located downstream of the forwarding pump to prevent the migration of resin fines. DWC forwarding pump P-7, an air driven reciprocating diaphram pump, provides the head to return flow to either source.

The SDS can process 15 gpm. The DWC Booster Pump, P-5, is provided to increase the pressure to 140 psig to overcome the high SDS differential pressure. P-5 suction pressure will vary inversely with pressure differential across the filter canisters. When the filter canisters are clean P-5 will experience maximum suction pressure. Since P-5 outlet pressure is controlled, pump flowrate varies. Pressure regulator V122 (PCV-26) controls SDS inlet pressure at 140 psig, bypassing excess flow past SDS. PSV R-1 is provided downstream of the DWC Booster Pump to prevent overpressuring the SDS due to V122 (PCV-26) failure. From the SDS, flow is routed to either the FTC or SFP.

In the event of high Sb-125 levels, the return flow from K-2 can be routed to the reactor coolant bleed tanks for batch processing through EPICOR II.

Sample points are provided upstream and downstream of each filter train. These samples are routed to sample box 1, a glove box located in the FHB. The glove box has a self contained blower and HEPA filter which discharge to the FHB ventilation system. Sample points are also provided upstream and downstream of ion exchanger K-2. These samples are routed to sample box 2, a laboratory hood located in the FHB. The hood is connected to combination blower/prefilter, HEPA filter package S-2 and discharges to the FHB atmosphere. The S-2 inlet dampers should be adjusted to maintain a 100 to 140 feet/minute face velocity at the sample box 2 hood. 3

1.3.2 System Components

F-7/8 Filter Canister Post Filter and DWCS Post Filter

Type: Disposable Cartridge
Model: Filterite No. 921273 Type 18M503C-304-2-FADB-C150

Rating: 0.45 micron nominal removal rating
Flow: 20 to 30 gpm

F-9, F-10, F-11, F-12 Fuel Transfer Canal/Spent Fuel Pool Filters

Type: Pleated sintered metal media
Model: Pall Trinity special product contained in a criticality safe canister
Rating: 0.5 micron Nominal Removal Rating
Flow: 100 gpm

K-2 Ion Exchanger

Type: Zeolite resin contained in a 4' x 4' HIC
Model: Nuclear Packaging 50 ft^3, Enviralloy, Demineralizer/HIC
Flow: 30 gpm

P-3 A/B Fuel Transfer Canal Pumps

Type: Vertical, 2 stage, submersible pump; Goulds model VIS, size 9AHC, 5.56 in impeller
Metalurgy: Stainless steel bowl, bronze impeller, 416SS shaft
Motor: Franklin Electric 25 HP, 3550 rpm, 460V, 3 phase
Rating: 220 gpm at 264 ft
Shutoff head: 289 ft.
Min Flow: 20 gpm (recirculation)

P-4A/B Spent Fuel Pool Pumps

Identical to P-3A/B

P-5 DWC Booster Pump

Type: Regenerative turbine, 2 stage, SIHI model AEHY 3102 BN 112.42.4
Metalurgy: 316SS casing with 316SS shaft, impeller, and internals
Motor: 5 HP, 1750 rpm
Rating: 15 gpm at 250 ft
Shutoff head: 390 ft (at min flow)
Min Flow: 5 gpm
Seals: Mechanical, John Crane type 1 with tungsten carbide seal faces

P-7 Forwarding Pump

Type: Air driven double diaphragm pump
Model: B.A. Bromley Heavy Metal Pump Model No. H25
Material: Stainless Steel with Viton diaphragms
Rating: 60 feet TDH at 60 gpm

PCV-26 Pressure regulator, SDS bypass
Capacity: 25 gpm
Model: Fischer Controls No. 98H

PSV R-1 Relief Valve
Model: Anderson Greenwood No. 81PS88-8
Capacity: 30 gpm
Orifice: Size E, 0.196 in^2
Set Pressure: 150 psig

PSV R-8, R-9, R-10, R-11 Relief Valves
Model: Anderson Greenwood No. 83MS46-4L
Orifice: Area: 0.049 in^2
Set Pressure: 130 psig

Sample Box 1
Type: Globe Box
Mfgr: Labconco
Model: No. 50002, Radioisotope Glove Box
Material: Fiberglass-reinforced polyester
Built-in Blower: 115 volt, 1/15 HP, variable speed
Filters: Prefilter, HEPA filter
Dimensions: 50" x 30" x 37"

Sample Box 2 3
Type: Laboratory Hood
Mfgr: Labconco
Model: No. 47810, Radioisotope-47 Laboratory Hood
Material: 316SS
Dimensions: 47" x 29" x 59"
Recommended Face Velocity: 100-140 ft/min

S-2 Sample Box 2 Filtration Module
Mfgr: General Dynamics, Reactor Plant Services
Model: PFB(H)-1000
Filters: Prefilter and HEPA Filter
Blower: 230 VAC, 5 HP, 20 AMP, 3450 rpm
Rated Capacity: 1000 CFM

For further information on valves and instrumentation, refer to the valve list (Ref. 15) and the instrument index (Ref. 14). For a listing of all equipment see the TMI-2 Recovery Mechanical Equipment List (Ref. 16). For piping information see the Standard for Piping Line Specifications (Ref. 17).

1.4 System Performance Characteristics

The system is designed to function in any of the modes of operation shown in Table 1 below.

Table 1

Fuel Transfer Canal/Spent Fuel Pool Cleanup System Operational Configurations

Filter Flow (GPM)		SDS Flow (GPM)		K-2 Flow (GPM)	
From FTC	From SPA	From FTC	From SFP	From FTC	From SFP
400 (200)	0	0	0	0	0
400 (200)	0	15	0	0	0
400 (200)	0	0	0	30	0
400 (200)	0	15	0	30	0
0	400 (200)	0	0	0	0
0	400 (200)	0	15	0	0
0	400 (200)	0	0	0	30
0	400 (200)	0	15	0	30
200	200	0	0	0	0
200	200	15	0	0	0
200	200	0	15	0	0
200	200	0	0	30	0
200	200	0	0	0	30

(numbers in brackets indicate 1 pump operation)

The operational mode is determined based upon which source needs to be processed. Normally, 400 gpm from the fuel transfer canal are filtered and 30 gpm of the fitrate is processed through DWC ion exchanger K-2. The total discharge flow (400 gpm) is returned to the spent fuel pool to create an inflow to the fuel transfer canal through the open fuel transfer tubes.

The other modes of operation are chosen based on the solids and Cs-137 concentrations in the sources. The filter flow rate is chosen based on the concentration of solids in the sources. If one source experiences a high solids loading, 400 gpm from that source could be filtered to more rapidly reduce the solids loading. During this time, the other source could not be processed through this system. During periods of high Cs-137 loading, an additional 15 gpm could be processed through the SDS which would reduce the recovery time of the source.

1.5 System Arrangement

References 7 and 8 present the positioning of equipment. Well pumps P-3 A/B, are submersed in 10 inch diameter wells in the north end of the fuel transfer canal in the Reactor Building. The wells are connected by a 6" flexible hose to skimmer U-7 located at the dam separating the deep and shallow ends of the fuel transfer canal. Well pumps P-4A/B are submersed in the northeast end of spent fuel pool "A" in the Fuel Handling Building. These wells are connected by a 6" flexible hose to skimmer U-8 located at the south end of the SFP.

The discharge of pumps P-3A/B and P-4A/B is routed to the filter canisters inlet manifold near the northeast end of the SFP. The filter isolation valves, vent valves, and manual control valves V090A/B (HV-64A/B) are also located there. The filter outlet manifold is adjacent to the inlet manifold.

Filter canisters F-9, F-10, F-11, and F-12 are submersed in the SFP in the north end of the dense pack fuel rack. They are connected to the inlet and outlet manifolds by 2-1/2 inch steel guarded, flexible, coded hoses equipped with cam and groove couplings. The coupling at the fuel canister is modified for long handled tool operation.

From the filter outlet manifold the water is routed either directly back to source or to the DWC ion exchanger K-2 or SDS for further processing. The DWC ion exchangers are located behind appropriate shielding in the northwest end of the Fuel Handling Building. The forwarding pump P-7 is located near K-2.

Sample box 1 is located at the southeast end of the spent fuel pool A and sample box 2 is on the DWCS platform near the DWC ion exchangers. 3

The system uses the following existing penetrations which have been modified for their temporary function. Armored hose is used downstream of penetration R-539 to the FTC.

Penetration No.	System	Modified Function
R-524	Spent Fuel Cooling	Discharge from Fuel Transfer Canal Pumps
R-539	Decay Heat Closed Cooling Water	Return to Fuel Transfer Canal

1.6 Instrumentation and Control

1.6.1 Controls

The components of this system are located in accessible areas of the Fuel Handling Building. With the exception of the DWC ion exchanger loop, valve alignment and adjustment is performed manually to achieve the proper flows to and from the various sources.

The flow to DWC ion exchanger K-2 is regulated automatically by flow control valve V08[illegible] ([illegible]). K-2 effluent is regulated automatically by level control valve V070 (LV-46).

1.6.2 Power

The pump motors are supplied with 480V power through a motor control center which is energized by an existing unit substation located in the Auxiliary Building. A stepdown transformer will provide 120 VAC for valve operation and the control panel.

1.6.3 Monitoring

Monitoring equipment is provided to evaluate the performance of the system and to aid in proper operation of the system.

PI-25 monitors the Booster Pump discharge pressure to verify the correct operation of both the pump and the bypass pressure regulator, V122 (PCV-26)

FI-15 and FQI-15 monitor the flowrate and total flow of filtered water routed to DWC ion exchanger K-2

AE-16 monitors the pH in the water leaving K-2 and SDS to verify this parameter was not altered during ion exchange 3

FI-23A and FQI-23A monitor the flowrate and total flow of filtered water returned directly to the FTC

FI-23B and FQI-23B monitor the flowrate and total flow of filtered water returned directly to the SFP

FI-60 & FQI-60 monitor flowrate and total flow to the SDS to measure system performance and to record water processed

DPI-22A/B monitor the differential pressure across the filter canisters to determine degree of loading and therefore time of replacement

LI-46 monitors the liquid level in DWC ion exchanger K-2

FCC-LI-102 and SF-LI-102 monitor the water level in the Fuel Transfer Canal and Spent Fuel Pool. They are panel mounted in the control room. The level indication system is a bubbler type system. A high or low level in the FTC and/or SFP will alarm (FCC-LAHL-103 and/or SF-LAHL-103) at the panel in the control room.

PI-81 and PI-82 monitor the pressure in the two instrument air manifolds in the Fuel Handling Building

The process fluid conditions can be sampled to determine the effectiveness of the system. The capability to obtain grab samples of process fluid has been provided at the inlet and outlet piping of the Fuel Transfer Canal/Spent Fuel Pool Filter Trains A and B. Grab samples may also be taken on the inlet/outlet lines to the DWC ion exchangers as well as several points in the SDS.

1.6.4 Trips

Low or high liquid levels in DWC ion exchanger K-2 will terminate flow to and from K-2. Both LSL-40 and LSH-40 trip closed the inlet isolation valve V069 and P-7 air supply isolation valve V156.

A locally mounted switch is provided at K-2 to override the level trips to fill and drain the ion exchanger. A signal alarm at the DWC control panel will notify the operator that the override is engaged.

1.7 System Interfaces

Those systems interfacing with the DWC are as follows:

a) Standby Reactor Pressure Control System (existing)
Use: Provide a source of borated water for backflushing
Tie-in: A single connection from SPC-T-4 downstream of SPC-V1 to the inlet manifold piping for the Fuel Transfer Canal/Spent Fuel Pool Filters, Trains A and B

b) Submerged Demineralizer System (existing)
Use: Provide a system for soluble fission product processing.
Tie-in: To downstream of pump WG-P-1 of SDS from downstream of Fuel Transfer Canal/Spent Fuel Pool Filters. From downstream of the SDS polishing filter to downstream of the DWCS manual control valves V097A/B.

c) Instrument Air System (existing)
Use: Provide source of instrument air to equipment.
Tie-in: At existing valves AH-V220 and IA-V171

d) Service Air System (existing)
Use: Provide a source of service air to the forwarding pump P-7.
Tie-in: Service Station 87 plus another station if needed

e) Dewatering System
Use: Allow periodic use of DWC ion exchanger K-2 for the Dewatering System. 3
Tie-in: Upstream of filter canister post filter F-8.

1.8 QUALITY ASSURANCE

The defueling water cleanup system is classified according to the safety functions of its parts. There are three classifications in this system:

a. Portions of the system associated with ion exchange processing are considered to be a radioactive waste processing system; therefore, these portions of the system shall be subject to the quality assurance guidelines contained in NRC Regulatory Guide 1.143.

b. The filter canisters are classified as nuclear safety related and are designed to prevent a condition that could result in a return to nuclear criticality of the fuel retained in the filters.

c. The remaining portions of the system are subject to the BNAPC non-safety-related quality assurance program.

The TMI-2 Recovery QA Plan will be applicable for work performed on site.

2.0 System Limitations, Setpoints, and Precautions

2.1 Limitations

The system is flow limited to 200 gpm through each filter train, 15 gpm through SDS and 30 gpm through the DWC ion exchanger K-2.

The filter canisters (F-9, F-10, F-11, F-12) are limited to a 45 psi pressure differential. At this point an alarm on a local panel will inform the operator of the need to stop and restart the system or to remove and replace the filter.

The post filters are limited to 10 psi pressure differential. At this point the filters are considered fully loaded and are changed out.

The system should not be started and stopped frequently since the canister filter precoat is lost during a shutdown; thus it will be necessary to reestablish a precoat on starting up before processing through SDS or K-2.

2.2 Setpoints

DPSH-22A & DPSH-22B Trip alarm at 45 psi pressure differential across the FTC/SFP filter trains A & B. 3

LSL-40 & LSH-40 Trip alarm, trip closed inlet isolation valve V069 and trip closed P-7 air supply valve V156, shutting down P-7. Low level set point is 10 inches below top of ion exchanger. High level set point is 4 inches below top of ion exchanger (i.e., ± 3" from normal liquid level).

PSV-R-1 Set to relieve at 150 psig with 10% overpressure to protect SDS.

PSV-R-8, R-9, R-10, & R-11 Set to relieve at 130 psig with 10% overpressure to protect the filter canisters from hydrogen/oxygen build up. 3

PCV-26 Regulates upstream pressure (SDS inlet pressure) at 140 psig.

SF-LIS-103 & FCC-LIS-103 Trip alarms on high or low levels in the SFP and FTC. Low level set point is 327 ft-5 in. High level set point is 327 ft-11 in.

2.3 Precautions

Due to the use of quick disconnect couplings, extra care should be taken to ensure that the couplings are properly connected and that they are connected in the proper locations.

The filter canisters operate by a surface filtration method, and their efficiency increases as a cake is built up on the surface of the media. Therefore, the build up of this cake is an important part of the filtration process. To prevent the migration of fines to the post filter, the ion exchange portion of the system should not be started until a cake has begun to be formed on the media. This can be verified by observing the turbidity of the filter effluent. When the filter train is started up, there will be an initial turbidity spike caused by smaller particles passing through the media. As the cake is built, these particles are stopped and the turbidity decreases. Once the turbidity reaches a level of 10 NTU or less, the ion exchange portion of the system can be started. Also, to prevent the breakdown of the cake, the system should not be started or stopped unnecessarily.

Caution should be taken during a change of pump feeding a filter
train. The new pump should be started and put on line before 3
shutting down the existing pump to protect the filter cake. Note
that outside of this brief exception no more than one pump should
feed one filter train.

The portion of the startup procedures concerning the well pumps should be strictly adhered in order to prevent the rapid filling of an empty manifold. This situation could cause a harmful pressure wave to develop which might damage the canister filter media.

The Reactor Building penetrations R-524 at elevation 293 ft-6 in and R-539 at elevation 320 ft are both below the water level of 327 ft-8 in. When in use the connecting piping/hose should be periodically checked since a line break will cause water to be lost from the system. When not in use, the hose should be isolated by closing valves V117A/B and V-099 (see discussion in section 4.5).

Periodically the face velocity across the sample box 2 hood should
be checked to verify it is within the range of 100 to 140 feet/min. 3
If the face velocity is too low the S-2 inlet dampers should be
readjusted accordingly.

3.0 OPERATIONS

3.1 Initial Fill

To initially fill the SFP & FTC borated water from the Spent Fuel Cooling System may be pumped from the borated water storage tank, DH-T-1, by the spent fuel cooling pumps, SF-P-1A/B. To fill the FTC the water may be routed through penetration R-524 and into the FTC through the 3 inch fill line downstream of the P-3A discharge check valve. To fill the SFP, V087A/B and V097B are opened and the borated water may be routed through the filter canisters and through the normal return process path to the SFP.

The system is filled initially by borated water from the standby reactor coolant pressure system through the backflushing system provided (see section 3.7). The filters are filled to the inlet and outlet manifolds.

To initially fill the DWC ion exchanger K-2, the level switch LSL-40 must be overrided (see section 1.6.4) until low level is attained. At this time the override switch should be returned to normal operation for further filling.

3.2 Startup

Prior to starting the system, the suction valve alignment is verified for the mode of operation selected. The valves to the ion exchange portions of the system are also verified to be closed. The pump discharge isolation valves are closed and the cross-tie valves are closed. The pump for one train is started and allowed to operate on minimum recirculation flow. The isolation valve for this pump is slowly opended. Then the hand control valve V090 A or B (HV-64 A or B) is opened 10% and any trapped air vented through manual vent valves located on the inlet and outlet manifolds. After venting, V090 (HV-64) is opened fully. Once this has been accomplished, the appropriate outlet cross-tie valve(s) (V096 A/B and V095) are opened. Flow is started by slowly opening the appropriate hand operated control valve (V097 A or B) until the desired flow is obtained. Note that V097 A/B are provided for flow 3
control of the system. Once one train has been started, the other train, if desired, may be brought into service in the same manner.

Filter performance will initially increase with time as a cake forms on the filter surface. Therefore, the filtered water should be returned directly to source without further processing until this cake forms, as evidenced by a decrease in turbidity. A turbidity below 10 NTU is sufficient to route to K-2 or SDS.

The DWC ion exchanger K-2 should always be brought to normal operating liquid level prior to operation of this portion of the system. Either borated flush water or filtered water of less than 10 NTU can be used. If the liquid level is below the low level trip, the level switch trip override must be engaged until low level is established (see section 3.1). Once normal level is established, the air supply solenoid valve V156 is opened. Pressure regulator V157 (PICV-58) is then manually adjusted to the pressure required to maintain the desired flowrate. Flow is slowly started to K-2 by opening flow control valve V085 (FV-15) until the desired flowrate to K-2 is obtained. K-2 effluent is automatically controlled by level control valve V070 (LV-46).

Processing water through the SDS requires opening the isolation valves for that portion of the system and starting the DWC Booster pump. These actions will allow 15 gpm to be processed through the SDS. For a detailed description of the SDS see reference 12.

The sample box 2 filtration module inlet dampers should be adjusted to create a 140 feet per minute face velocity across sample box 2. 3

3.3 Normal Operation

Normal operation of the system is in one of the modes shown in Table 1 of Section 1.4. The mode of operation is chosen based on what source is to be processed and what the particulate and radioactivity concentrations of the sources are.

3.4 Shutdown

The steps to bring the system to a shutdown condition are basically the reverse of the startup procedure. The ion exchanger flow is brought to zero gradually by remote operation of upstream control valve V085 (FV-15). Correspondingly, level control valve V070 (LV-46) will gradually terminate flow from K-2. After termination of flow the inlet isolation valve V069 is closed and the P-7 air supply isolation valve is closed. If the SDS is in use, the booster pump is switched off and isolation valves V111, V139, and V102 are closed. Following this, the well pumps are switched off and the pump isolation valves and the cross-tie valves are closed.

3.5 Draining

The majority of the system can be drained to the spent fuel pool. The filter canisters can not be drained, since they are submerged in the SFP. The piping to/from penetrations R-524 and R-539 must be drained to the Auxiliary Building sump since the penetration elevation is below the spent fuel pool water level. The DWC ion exchanger K-2 can be pumped out to either source, FTC or SFP, or to the reactor coolant bleed tanks via a portion of the SDS. A switch is provided to override the low level switch for pumping out K-2.

3.6 Refilling

The fully drained system may be refilled in the same manner that the system was initially filled. A partially drained system may be refilled by using either the back flush system (see section 3.7) or the well pumps (see section 3.2).

3.7 Infrequent Operations

Flushing of the system may be performed when the internal contamination level gets high or prior to internal maintenance work. The system is shutdown (see Section 3.4) prior to flushing.

One flushing option is gravity flush from SPC-T-4. Borated water is atored in the charging water storage tank, SPC-T-4, located at the 347 ft. elevation in the Fuel Handling Building. This tank is connected to the DWCS. Either filter train may be flushed without stopping flow through the other.

Flushing may be accomplished by opening one of the inlet valves from the flushing system (depending on which portion of the system is to be flushed) and then routing the flow to the fuel transfer canal or the spent fuel pool. After sufficient time has been allowed to flush the system, the inlet valve from the flushing system is closed, and the system is then restarted following the procedures in Section 3.2.

3.8 Transient Operations

The results of loss of pumps or filter train misalignment are flows not returning to the proper source. However, since this is the normal operational mode of the system and since the sources are connected by the fuel transfer tubes, the results of these transients are negligible. Vent or drain valve misoperation would have the same effect as a line break (see section 4.5) but could be more readily rectified.

4.0 CASUALTY EVENTS AND RECOVERY PROCEDURES

4.1 Loss of Power

A loss of power to any portion of the system would shut that portion of the system down. No adverse conditions would result.

4.2 Loss of Instrumentation/Instrument Air

Loss of instrumentation would hamper operations due to loss of monitoring capability but no adverse conditions would result and the system could be safely shut down until the problem is resolved.

Loss of a single instrument channel will result in the loss of indication for that channel and, for those channels that have control features a flow mismatch. This flow mismatch will result in an automatic ahutdown of the affected portion of the system.

Loss of either the spent fuel pool or FTC level monitoring system will be noted when compared with the other. The readings should normally be the same since both water bodies are in communication via the fuel transfer tubes. Neither system has control features.

Loaa of instrument air will take the individual components to their fail aafe position. Flow miamatchea induced by loaa of air will result in automatic trips.

On loss of instrument air, level control to the ion exchanger would be lost. But both the inlet isolation valve V069 and the outlet level control valve V070 (LV-46) would fail closed isolating the ion exchanger.

4.3 Deleted

4.4 Filter Media Rupture

A failure of the filter media in the canister could potentially release fuel fines to the ion exchange portion of the system. The SDS is equipped with a sand prefilter which has borosilicate glass to control reactivity (see ref. 12) and the DWC filter canister post filter precedes DWC ion exchanger K-2. There are differential pressure gauges supplied on the filters to determine if they are loading. Loading of the SDS prefilter or the filter canister post filter could indicate ruptured filter media.

The recovery procedure is to isolate the filter trains and find the ruptured filter by observing the differential pressure versus flow for each individual canister. Lower differential pressure for a given flow will indicate that this filter is ruptured. That canister or canisters and the post filter cartridge and/or SDS sand filter would be replaced and the system restarted.

4.5 Line and Hose Break

If a rupture occured in the system, the pumps could deliver fuel transfer canal and/or spent fuel pool water to the Fuel Handling Building or the Reactor Building. This action would lower the level in the canal and the pool. A drop of one inch in canal/pool level is approximately equivalent to 1250 gal. A level loss would be detected and alarmed (see setpoints section 2.2) by at least one of the two redundant level monitors provided for the canal/pool. The operator would then shut the system down.

Process water hoses are employed in three services in this system; filter canister inlet/outlet, skimmers to well pumps, and downstream of penetration R-539.

If a filter canister inlet/outlet hose ruptures, that canister will be isolated and the hose replaced. Since these hoses are submerged in the SFP, this results in no net water loss.

If a hose connecting the skimmer (U-7 or U-8) to the well pumps breaks, then the ability to surface skim will be hampered or lost, but pump capacity will not be deminished nor will there be a loss of water.

If the hose on the FTC return line downstream of penetration R-539 breaks, then process water will be lost to the Reactor Building sump. The resulting loss in level would be detected and alarmed by the canal/pool monitors. This hose is steel armored to minimize accidental damage. Check valves V-235A/B are provided to prevent siphoning the FTC if the hose (or connecting line) breaks.

Furthermore, the normal return path is to the SFP; thus this hose is not normally used. When not in use this hose will be isolated by closing valves V117A/B and V099 to minimize the effect of a hose break.

A break on the P-3A/B discharge line which uses penetration R-524 would cause process water to be lost to either the Reactor Building or the Fuel Handling Building. The water loss would be detected both by a decrease in the monitored flowrate returned to the fuel pool or fuel transfer canal and also by the drop in fuel pool and/or transfer canal level. When the fuel transfer canal pumps, P-3A/B, are not in use, the discharge valves V002A/B and valve SF-V103 should be closed. This would prevent a syphoning of the FTC when the pumps are not in use.

5.0 SYSTEM MAINTENANCE

The maintenance procedures are the recommended practices and intervals as described by the equipment vendors. | 3

6.0 TESTING

6.1 Hydrostatic Testing

All piping and hose will be hydrostatically pressure tested. Testing of hose will be done after couplings have been attached. Pipe will be tested outside the buildings.

6.2 Leak Testing

All accessible connections will be initial service leak tested after the piping is assembled.

6.3 Instrument Testing

All instruments will be calibrated by vendors. Complete electric/pneumatic loop verification will be done during start-up.

7.0 HUMAN FACTORS

Filter canister hoses are coded for quick identification of inlet versus outlet.

Extensive use of hoses is made, especially in the Reactor Building, allowing quick installation and use of existing radiation shielding. Hoses expected to be frequently disconnected are equipped with quick disconnect couplings for ease of removal and replacement.

The following human factors guidelines have been incorporated into the design of the DWCS control panel:

- The panel includes all controls and displays required for normal operation.
- Displays provide immediate feedback that the system has responded appropriately to an operator's action.
- Controls and displays are laid-out for a left to right flow path.

- Mimic lines are used to clarify flow paths.
- Control devices are mounted to 3 to 6 feet above the floor.
- Each control device has a nameplate.
- Light bulbs are replaceable from the front of the panel.
- Recorders are grouped on the right side of the panel away from the flow path.
- Adjustments to recorders and controllers can be performed from the front of the panel.